COTTON MANUAL

BROADBENT

LIBRARY


SOUTHEASTERN MASSACHUSETTS UNIVERSITY
· UNITATE · 1895 · FORTIOR ·

A COTTON MANUAL

FOR

MANUFACTURERS AND STUDENTS

BY

J. T. BROADBENT

Instructor in Carding and Spinning,
Bradford-Durfee Textile School, Fall River, Mass.

1905
LORD & NAGLE CO.
Boston, Mass.

INDEX TO QUESTIONS.

		Page
1.	What is cotton?	11
2.	Brief general description of a cotton fibre. Fig. 1	14
3.	The chemical composition of cotton.	20
4.	Principal cotton growing centres by quantity	22
5.	Principal cotton growing centres by quality..	22
6.	Principal requirements for cotton cultivation..	22
7.	State producing largest crop of American cotton, and leading markets in United States	23
8.	Five leading seaports from which cotton is shipped	23
9.	Beginning of cotton cultivation in U. S.	24
10.	Port of first shipment of American cotton	24
11.	States included in the cotton growing section of the United States	24
12.	World's most important crop	24
13.	Cotton imported into the U. S.	25
14.	Preparing land for cotton cultivation	25
15.	Time for preparing land	26
16.	Is fertilizing always necessary?	27
17.	Selection of cotton seed	29
18.	Mechanical and hand planting	31
19.	The two principal periods in the life of a cotton plant	32
20.	Meaning of "Chopping-out"	33
21.	Time between planting and picking	33
22.	Picking season	34
23.	Best time to pick cotton	34
24.	A year's work on a cotton plantation	34
25.	Leaf and stalk in cotton	35
26.	Home of the cotton plant	35
27.	Principal cottons manufactured in the U. S.	35
28.	Name and grades of best cotton grows. (Sea Island.)	36
29.	American cotton	37
30.	Long Stapled Upland cotton	38
31.	Gulf cotton	40

32. Upland cotton and Texas cotton 41
33. Grades of American cotton with their variations in price 42
34. Meaning of "Spot," "Futures," and "C. I. F. & 6" as applied to cotton buying 44
35. Terms upon which "spot" cotton is sold 45
36. "Contract in futures" 45
37. Egypt's position as a cotton producing country 47
38. Varieties of Egyptian cotton 48
39. Grades of Egyptian cotton 49
40. India's position as a cotton producing country 49
41. India's cotton producing territory 49
42. Varieties of Indian cotton 50
43. Grades of Indian cotton 51
44. South American cotton 51
45. Grades of Brazilian cotton 53
46. Mexican cotton 54
47. Chinese cotton 54
48. Asiatic cotton general quality 55
49. Selection of cotton 55
50. Important cotton markets outside of U. S. .. 57
51. Uses of cotton in addition to cloth 58
52. Is the fibre the only portion of the plant which can be used for commercial purposes? ... 59
53. Fibre and seed in "seed-cotton" 60
54. Ginning and its object 60
55. Ginning of American cotton 61
56. General description of a saw gin 63
57. Production of a saw gin 64
58. Rivals of the saw gin 65
59. The deterioration of American cotton 65
60. Defects in cotton as received at the mills 67
61. Method of packing prior to baling 68
62. Weight and dimensions of American bales ... 68
63. Comparison of American and foreign bales .. 68
Chapter on Cotton Baling.
Chapter on Cotton Mixing.

PREFACE.

This work is dedicated to the students of the various textile schools of the United States, by whom it may be used as a text book covering a brief general study of the cotton fibre, together with as many of the essential points in connection with the cultivation and marketing of this important crop, as the average student requires.

It will also serve as a handy reference book for persons connected with, or interested in cotton manufacturing, as the arrangement in catechism form will assist in readily obtaining a direct answer to questions bearing upon any particular branch of the study; at the same time the entire volume forms a treatise on cotton from the seed to the mill.

In the preparation of this work the author has received assistance from many works on cotton and cotton cultivation, some of which are referred to in the text; notably the U. S. Dept. of Agriculture, and Col. A. B. Shepperson of the N. Y. Cotton Exchange, to whom I take this opportunity of expressing my thanks and appreciation. I also wish to thank the Eagle Gin Co. of Bridgewater, Mass., and the Howard & Bullough Mch. Co. of Pawtucket, R. I., for machinery illustrations.

J. T. B.

January, 1905.

A COTTON MANUAL

FOR

Manufacturers and Students.

Question 1. What is Cotton?

Answer. Cotton is the downy product of a plant which belongs to the family of Mallows, and is indigenous to almost all tropical and semi tropical climates.

Owing to the fact that the cotton plant yields so readily to the varying conditions of soil and climate, there is at the present time a large variety of cottons, each having some peculiarity which is considered enough to place it under a distinct class, or species; the above, together with the tendency to hybridize, make it almost impossible to keep track of every variety. An idea of such an undertaking can be obtained from the fact that the U. S. Dept. of Agriculture in 1896 recorded about 130 varieties.

In the United States, India, Egypt, and the majority of cotton growing countries the cultivation of cotton is usually treated as an annual plant, i .e., new seeds are sown every year.

In South America the plant is permitted to stand for about 5 or 7 years, or so long as it will give a satisfactory return of fibre; this is called a perennial plant. Under very favorable conditions this species will produce two crops in one year.

The botanical species of cotton vary considerably in number, according to different botanists; but the following represents the four principal species.

Gossypium Barbadense.
Gossypium Herbaceum.
Gossypium Hirsutum.
Gossypium Arboreum or Peruvianum.

The Barbadense, generally speaking, includes mostly the long stapled cottons such as Sea Island (either the American or Peruvian varieties), and Egyptian.

This species is supposed to have obtained its name from the Barbadoes; although it may be cultivated in the Bahamas, Lesser Antilles or any region near the sea, between 12 and 26 degrees N. Lat., as its principal requisite is a warm, humid atmosphere.

The plant grows to a height of from 4 to 8 feet, and usually the seeds are black and smooth; the latter referring particularly to the downy covering which is present to some extent on all other varieties of seed.

The Gossypium Herbaceum species and the G. Hirsutum, refer to the class of cotton represented by American Uplands, and undoubtedly indicate the "grey seed" and "green seed" varieties respectively.

The plant attains a height of 6 feet in some cases, although 4 feet would be nearer the average. In each case the seeds are covered with a short firmly adhering fibre, in addition to the regular fibres.

The product of the Herbaceum species is usually shorter than that of the Hirsutum

species and is supposed to represent the bulk of Indian, Chinese, African, and Asiatic cottons, while the Hirsutum refers more especially to the American cottons.

The Gossypium Arboreum is usually spoken of as the "tree cotton" and is found in Asia, Central and South America, and India.

The plant may reach a height of 15 or 20 feet, and the seeds may be classed amongst the "green" variety, being covered with a greenish down, beneath the usual fibre.

This species is usually treated as a perennial plant, i. e., the seeds are not sown every year, but the plant is allowed to stand and produce fibre for 5 to 7 years in succession. It requires little cultivation, and in good seasons will yield two crops of fibre.

The separation of the fibres from the seeds is more difficult in the "green" and "grey" seeded varieties than in the "black" seeded varieties, and the operation is usually performed on different machines.

A cotton plant is composed of roots, stems, leaves, bolls, seeds, and lint or fibre, in about the following proportions; although soil and location, with care in cultivating, may increase the per cent. of fibre. An approximate per cent. for the roots is about 8 of the entire weight of the plant; stems or stalk may be 23 per cent.; leaves about 20 per cent.; bolls 14 per cent.; seed 23 per cent., and lint or fibre 11 per cent.; the water being omitted in the above, although it may when taken into consideration, equal about 10 per cent. of the total weight of the plant.

2. Give a general description of a cotton fibre.

When viewed under the microscope, a cotton fibre appears as a flattened twisted tube, thicker at the edges than in the centre, and being of equal diameter for about 3/4 of its length; after which it gradually tapers for the remainder of its length, at the same time becoming more cylindrical.

This peculiarity of the cotton fibre to twist on its axis is the principal cause of cotton fibres being so admirably adapted to spinning, as it permits the fibres to interlock with each other, in addition to entwining about each other through the introduction of artificial twist.

Unripe fibres have a very small amount of natural twist, and consequently will not produce as strong a thread. See Fig. 1.

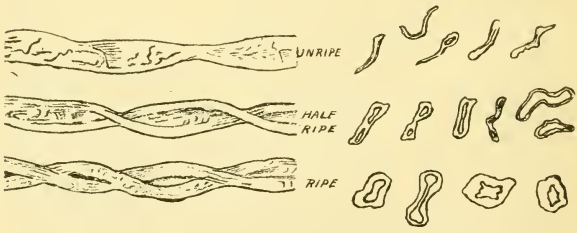

FIG. 1. COTTON FIBRES.

The fibre is made up of four parts, viz:

1. The outer membrane forming the skin of the fibre, which is covered by an oily deposit known as cotton wax.

2. Cellulose which forms the body of the fibre.

3. A central spiral deposit of a little harder nature than the rest of the fibre.

4. A secreted matter in the centre, somewhat similar to the pith of a quill.

It is claimed that a fibre of cotton during the process of growth is a true cylindrical tube, with an open space in the centre running almost its entire length. This space contains a fluid from which the fibre is constructed; it flowing through this tube in much the same manner and for the same purpose as does the blood in the arteries of a human body. As soon as this cylindrical tube has reached the age of maturity the supply of this circulating fluid is entirely cut off, and is no doubt as in the case of a dying leaf on a tree, drawn back into the seed from which the growing fibre has got its nourishment. This cylindrical tube, having reached the age of maturity, and the nourishing fluid having been drawn back into the seed, collapses and becomes, in the place of a perfectly cylindrical tube, a flattened one, as is shown by the microscope. See Fig. 1. In cotton we find this tube-like formation so thin and delicate that when the process of ripening has taken place the tube collapses into a thin ribbon, which, in turn, curls up and twists itself into a spiral form. This is a feature that is much desired by manufacturers. When the formation has a little more substance to back up the structure the hollow tube retains more of an elliptical form in construction, or else it curves together in two

opposite sides and forms a cross section that looks almost like a figure eight (8).

Covering the cotton fibre is a sort of varnish or oleaginous deposit, technically known as cotton wax. This is said by Monie to amount to about 2 per cent. by weight of the fibre, and must be removed before the fibre is dyed, otherwise the coloring will be poorly done. The presence of this substance on the fibre is readily shown by the difficulty with which ordinary cotton absorbs moisture. Absorbent cotton is cotton that has been treated in such a way that all the cotton wax is removed. When cotton fibre is manufactured into yarn, the process requires a certain amount of heat in order to drive away the viscosity of this substance which has a tendency towards licking the rollers. The hollowness or tube-like construction and the twist of fibres, with the serrated or corrugated edges depends upon the gradual development of the fibre. According to latest investigations by some botanists, the cotton fibre of a good staple consists of from 300 to 800 twists in its length, and in an ordinary variety, the number ranges to over 150.

The more the fibre has of the natural twist, the greater its capacity to hold the neighboring fibre firmly; and this tendency is its chief recommendation, if we utilize the fibre for turning into yarn.

Microscopic tests reveal further that these twists in the fibre are not always of the same length, but that some are long and some short, while some portion of the fibre is entirely without twist. One special feature which has

been noticed is, that in some of the fibres, the twist is along one side as well as along the other, and twists like these, variable in their lengths and direction, are all useful in making the fibre commercially valuable. The absence of serrated or corrugated edges in a fibre is due to solidity.

A delicate, smooth and even fibre, such as the cotton fibre, will be, as a rule, an elastic one also. If the gummy substance, which forms the inner coating of the walls of the fibre, is given to it gradually through the constant circulation of that fluid, it will steadily increase the thickness of the walls and give the fibre its perfect maturity. If this gummy substance is allowed to go into the fibre and give the walls of the fibre a coating of a condensed nature, the fibre is sure to lose its tendency towards taking more twist, and retaining moisture, known as water of hydration.

These two drawbacks tend, moreover, to affect adversely the fibre so far as the maintaining of its elasticity is concerned.

As to the individual strength of cotton fibre, this depends upon its diameter, and in this respect Indian cotton stands first. Here we must remember, that this strength is of little use when yarn is to be made out of these fibres. Strength of yarn does not depend upon the individual strength of cotton fibre, but upon the number of twists and fineness in diameter of each individual fibre, as well as upon the length of the fibre. A fibre which is thick in diameter, is always shorter in length

than a thinner fibre, and therefore not capable of being bound into as strong a yarn as the longer but weaker fibre. Again the thicker fibre being greater in diameter, the yarn made of such fibres shows a smaller number of fibres in its cross section; it is therefore weaker in strength than yarn which is composed of smaller diameter fibres which lie closer to one another and give more strength. The following table shows how fibres of larger diameter are stronger in their individual strength but wanting in length or staple:—

Classes of Cotton.	Mean length of the fibre.	Mean diameter of the fibre.	Mean strength of the fibre in grs.
Sea Island	1.7 inches	1/1570″	100
Egyptian	1.4 inches	1/1526″	130
American Gulf	1.1 inches	1/1310″	140
Indian best quality	.9 inches	1/1185″	150

The above is the average of several tests made from the same sort of cotton. As regards the strength, the weight was suspended at different distances, and the variation found was from 18 to 300 grains. The fibre has thus been observed to be weaker at the end farthest from the seed and gradually stronger towards the seed.

If a very immature boll be cut transversely, the cut section will show that it is divided by longitudinal walls into three or more divisions; and the seed will be shown attached to the inner part of each division. The seeds retain this attachment until they have nearly reached their mature size, and the growth of lint has begun on them; when their attachments begin to be absorbed and by the in-

creased growth of the lint the seeds are forced to the centre of the cavity. The development of the fibre commences at the end of the seed farthest from its attachment, and gradually spreads over the seed as the process of growth continues. The first appearance of the cotton fibre occurs a considerable time before the seed has attained its full growth, and commences by the development of cells from the surface of the seed. These cells seem to have their origin in the second layer of cellular tissue, and force themselves through the epidermal layer, which seems to be gradually absorbed. The cells which originate the fibre are characterized by the thickness of their cell walls when compared with their diameter. The method of growth, according to Bowman, is the successive linear development of cells, the walls of which are absorbed at the point of contact until an elongated cell is produced, which constitutes the cotton fibre. The continued growth of this mass of fibre assists in bursting open the pod when the period of maturity is reached.

W. I. Hannan says in his Textile Fibres of Commerce, "there is no fracture or bursting of the fruit by the pressure of the fibres from the inside. The opening of the capsule does not depend upon the pressure within, but on the drying up of the coherent membrane sutures or valves of the capsules."

The length of the fibre varies considerably on different parts of the seed, being longest on the rounded end of the seed and shortest at the pointed end of the seed.

3. What is the chemical composition of cotton?

According to the experiments made by the Tennessee Experiment Station the following were found to be the approximate component parts of cotton.

Water	6.74%	Cellulose	83.71%
Ash	1.65%	Nitrogen	5.79%
Protein	1.50%	Fat	0.61%

G. Von Georgievics in his recently published work on Chemical Technology of Textile Fibres, gives the following:

Cellulose	87 to 91%
Water	7 to 8%
Wax and Fat	4 to 5%
Protoplasmal residue	5 to 7%
Ash	12%
Coloring matter	small %

The following particulars were obtained in a recent analysis by Messrs. Davis, Dreyfus and Holland:

Carbonate of Potassium	33.22%	Soluble in water.
Chloride of Potassium	10.22%	Soluble in water.
Sulphate of Potassium	13.02%	Soluble in water.
Carbonate of Sodium (Soda Ash)	3.35%	Soluble in water.
Phosphate of Magnesium	8.73%	Not soluble in water.
Carbonate of Magnesium	7.81%	Not soluble in water.
Carbonate of Calcium, or lime	20.26%	Not soluble in water.
Peroxide of Iron, or Ferric Oxide	3.4%	Not soluble in water.

In Dr. Royle's work on the Culture of Cotton in India, two analysis of ash obtained by the combustion and subsequent incineration of Orleans cotton fibre and seed, made in 1843

are interesting. The analysis of the ash obtained by burning the fibre is:

	Parts
Carbonate of Potash	44.29
Phosphate of Lime	25.34
Carbonate of Lime	8.97
Carbonate of Magnesia	6.75
Silica	4.12
Sulphate of Potash	2.90
Alumina	1.40
Chloride of Potassium, Chloride of Magnesium, Sulphate of Lime, Phosphate of Potash, Oxide of Iron (a trace), and loss	6.23
	100.00

There is a well-known analysis of the ash produced when Sea Island cotton is carefully burned and the residuum incinerated, which was made by Dr. Ure. The composition of the ash was as follows:

Matters Soluble in Water.

Carbonate of Potash	44.8
Muriate of Potash	9.9
Sulphate of Potash	9.3

Matters Insoluble in Water.

Phosphate of Lime	9.0
Carbonate of Lime	10.6
Phosphate of Magnesia	8.4
Peroxide of iron	3.0
Alumina, water, and loss	5.0
	100.00

Analysis will show in some of the purer varieties of cotton that the cellulose may reach 87 per cent., while the ash will vary from about 1 1/4 per cent. in the finer varieties, to 5 or 6 per cent. in the coarser varieties, or short stapled cottons.

Again the water may vary from 6 to 8 per cent., and this natural moisture is one of the essential features which gives cotton such excellent spinning properties so far as its pliability is concerned.

4. Name the principal centres which contribute to the world's cotton crop.

The following countries represent the chief contributors, in order of quantity produced: United States, India, China, Egypt, Asia, South America, Africa and Turkey.

5. Place the centres named in question 4 in order for quality of cotton produced.

United States produces Sea Island.
Egypt produces Egyptian.
South America produces Peruvian and Brazilian.
United States produces American.
Chinese Empire produces Chinese.
India produces Indian.
The cotton grown in Asia, Africa and Turkey is a little better than the Indian varieties.

6. What are the principal requirements for successful cultivation of cotton?

Cotton may be successfully cultivated in countries and states, having tropical or semi-tropical climate, with about 8 months entirely free from frost. The belt may be represented between 37 degrees North and South latitudes.

The atmosphere must be warm and moist, while the soil must contain lime and potash; and although these properties may not be pres-

ent naturally, they are now introduced artificially in the form of fertilizers.

In the United States cotton is cultivated in practically three classes of soil:

1st. The red soils of Georgia, North and South Carolina, and some portions of Alabama, Mississippi, and Texas.

2d. The rich black loam of Alabama, Mississippi and Texas.

3d. The alluvial soil of the Valleys of the Santee, Alabama, Tombigbee, Pearl, Mississippi, and Red Rivers.

7. What State produces the largest cotton crop in the United States; also give the names of several cotton markets having sales of over 100,000 bales "Spot Cotton"?

Texas usually places the first new bale of cotton on the market and also produces the largest crop.

The cotton markets in the above class in order of importance are:

New Orleans, La.
Houston, Texas.
Memphis, Tenn.
Little Rock, Ark.
Savannah, Ga.
Augusta, Ga.
Montgomery, Ala.
New York, N. Y.
Galveston, Texas.

8. Give five of the leading seaports in United States from which cotton is shipped.

The five leading ports are:

New Orleans, La.
Galveston, Texas.
Savannah, Georgia.
New York, N. Y.
Charleston, S. C.

9. When did cotton cultivation commence in the United States?

The cultivation of cotton as a commercial fibre, began in Georgia, about the 16th century. Georgia was then a small Spanish colony between Florida and South Carolina. In 1621 cotton sold in the colony of Virginia at 8d. (16 cents) per pound.

10. From what port was the first shipment of American cotton made?

The first shipment was from Savannah; exact time questionable. In 1748, seven bags of cotton were exported from Charleston, S. C.

11. Name the states included in the cotton growing section of the United States.

North and South Carolina, Georgia, Texas, Florida, Virginia, Alabama, Louisiana, Mississippi, Arkansas, Tennessee, Missouri, and Kentucky.

12. What country produces the most important cotton crop? Why is it the most important?

The cotton crop of the United States. The above is the most important, from the fact that it practically controls the price of the

entire market; again, it is the largest crop in the world, and its adaptability for general domestic use places it before other cottons for the manufacture of such goods as are most commonly used.

13. Is there any cotton imported into the United States, if so of what variety is it generally?

Egyptian cotton is imported into the States, and is used for fine cotton goods, hosiery, and other special purposes.

Rough Peruvian is also imported, but not in such large quantities; in fact on the authority of Mr. A. B. Shepperson "not a single bale" is used except to mix with some other fibre; principally wool.

14. What is meant by preparing the land for cotton cultivation?

The work of preparing the land includes the following:

1st. "Breaking up," i. e., the breaking up of the old stalks which are remaining from the last crop, and turning them under by means of a plow, so that they may act as fertilizer by decaying before time for sowing the next crop. This may commence at any time from January to March, according to the State, and a general statement may be given only; viz.: breaking up commences as early as convenient after the crop has been picked. It is customary in some plantations to allow the cattle to eat off the leaves or smaller stalks from the plant before "breaking up;" again, if the stalks are too large for satisfactory treatment as above, they

are usually burned. (It may be well to mention incidentally at this point that bagging is sometimes made from the stalks, while the roots furnish an extract used as a medicine.)

2d. After "breaking up" the fertilizer can be applied, and the soil harrowed; this operation depending upon the kind of fertilizer used and the method of applying it.

3d. "Bedding up" or laying off the land into beds; these varying from 2 1/2 to 6 feet between each bed, the distance depending upon the particular kind of cotton to be cultivated; it is customary for fertilizer in the shape of a powder to be applied to the land at this point, by plowing a furrow up the centre of each bed and depositing the fertilizer into it.

15. When does the work of preparing the land commence?

When we consider the difference in latitude between the State of Texas and Virginia, together with the different classes of soil, etc., it will be seen that the above question has a great range; for instance, in Texas and Florida preparation is commenced in January; while in Georgia, Mississippi, Alabama, Louisiana, and Arkansas it commences in February; and in the more northern States commences as late as March. It is, however, the object of farmers to begin as early as possible after the previous crop is disposed of at the gin.

The following table is given by A. B. Shepperson of the New York Cotton Exchange:

States.	Usual Date to begin preparing Land.	Usual Date to begin planting.	Usual Date to finish planting.	Usual Date to begin picking.	Usual Date to finish picking.
N. Carolina	Feb. 25	April 15	May 10	Sept. 1	Dec. 10
S. Carolina	Mar. 5	April 15	May 7	Aug. 15-Sept. 1	Dec. 1
Georgia....	Feb. 1	April 10	May 1	Aug. 15 to 20	Dec. 1
Florida....	Jan. 20	April 1	May 1	Aug. 10	Dec. 1
Alabama...	Feb. 1	April 5	May 10	Aug. 10 to 20	Dec. 15
Mississippi	Feb. 1	April 5	May 10	Aug. 10 to 20	Dec. 15
Louisiana .	Feb. 1	April 1	May 10	Aug. 1 to 15	Dec. 15
Texas*.....	Jan. 15	Mar. 15	May 10	Aug. 1.	Dec. 20
Arkansas..	Feb. 15	April 15	May 15	Aug. 15 to 20	Jan. 15
Tennessee.	Mar. 1	April 15	May 15	Sept. 1 to 10	Jan. 15

*In a portion of Texas north of latitude 30.50', the dates for preparing land, planting, and picking, are about four weeks later than the dates given above.

16. What is meant by fertilizing? Is it always necessary on all lands?

Fertilizing is the method by which land can be artificially assisted to produce better results than it would if left in its natural state.

The best fertilizer is that which contains the most food for the plants under cultivation. There are several varieties used in cotton culture, some of which are entirely chemical; others are made from the waste obtained at the ginnery or cotton seed oil mills, or by a mixture of crushed bones and stable manure, or general refuse from the large meat dressing houses throughout the country. The amount of fertilization, depends upon the natural qualities of the soil; although possibly all lands receive some.

Dr. Ure is of the opinion that manure most suitable for imparting vigor to cotton fibre

should contain nutrosaline matter with alkaline, calcareous and magnesium bases. An expert holds that if farmers were to remove only the lint from the cotton plant and leave the whole plant with stems, leaves, seeds, etc., to rot in the field, the permanent loss to the soil would be nothing but oil, which contains very little of manuring property. Manures prepared from vegetables, stable refuse, ashes, salts, and from fish, both in the dry and wet state are largely used, and the properties of wood ashes introduced recently by Western scientists is finding favor on account of its containing 4 to 6 per cent. or more of potash, as well as its property for protecting plants from insects. Fertilizer works are generally attached to cotton seed oil mills, where cotton seed meal, together with phosphate rock, horn and hoof waste, dried blood, bone meal, etc., are judiciously mixed in their manufacture. There are many types of fertilizers in the market suitable for differences of soil and climate, as for various sorts of cultivated land. By the use of special fertilizers, the crop of a field can be hastened or put off at will, and any modification forced and obtained. The state of the land, the quality of the seed, atmospheric changes, and some other points are, of course, taken into consideration before any particular kind of fertilizer is used. Generally the quantity required of this manure is from half a ton to one ton per acre. Analysis of the cotton fibre as well as of different soils have assisted greatly in bringing these various kinds of fertilizers to such a point of perfection and

usefulness that one can, as it were, mould the cotton plant in any way he pleases. In short, the fertilizer is a substance which gives vitality to any one or more components of either the cotton plant or the soil, and it is, therefore, one of the most important aids to the growing of cotton plants.

A mild climate is favorable to cotton crops. Extremes of either cold or heat, heavy rains continued for a long time, or very scanty showers, are all detrimental to its growth; the weather again, should neither be too dry nor too moist; neither heavy floods nor droughts, nor a sudden change in temperature leading to variation in the amount of moisture is desirable. Especially during the period the young plant is growing, mild and moderate climatic influences are needed. In short, uniform heat and humidity are the two essentials required for a good cotton crop of fine and good texture, and if any substance deficient in the soil for promoting good fibre is supplied in the shape of fertilizers and manures, there is every probability that the much prized fineness in diameter, the smoothness and the evenness of the fibres can all be obtained in a great measure.

17. Need there be any precaution in selecting cotton seed; if so, why?

The above question if answered in detail would cover many points extending into the hybrid species. A general statement may be given, covering the general cultivation of any one particular variety as an answer. For

instance some farmers reserve the seed from the first picking, to use for their next year's crop.

The following is a reprint from the U. S. Department of Agriculture on this subject:

The Selection of Seed.

It is a well known fact that races of cotton become mixed and impure, unless special care is taken to prevent crossing with other sorts. If, therefore, fields of long-staple Upland cotton are growing in the vicinity of fields of ordinary short-staple Upland cotton, the seed for planting should be taken at some distance from any short-staple plants. It is desirable to locate the seed field off by itself, half a mile or more from any other cotton. Besides precautions to keep the seed pure, it is also very desirable that some careful method of seed selection be regularly followed. It is desirable to keep the variety up to its full productiveness and better adapt it to local conditions, and this may be accomplished by simple and inexpensive methods of seed selection. The following is a simple method, and one which is easy of application:

Choose one or more careful pickers that remain on the plantation continuously from year to year, and train them to recognize the best plants; that is, those most productive, earliest in maturing, and having the largest, best-formed and most numerous bolls. It is also advisable, where time permits, to have these

special pickers learn to pull the lint from the seed cotton and test it as to length, to see that this quality is maintained up to the maximum. Each year, before the first and second general pickings, have these skilled pickers go over the field and pick the cotton from the best plants only. These pickers should of course be paid by the day, and not according to the quantity picked. Sufficient seed cotton should be thus carefully picked to furnish, when ginned, the amount of seed necessary for planting the next year. To avoid mixing, preserve such seed separately, and gin it on a carefully cleaned gin.

There is some difference of opinion as to the best cotton to pick for seed. Most planters claim that it is not best to take the cotton either from the first bolls that open, as these are liable to be small and imperfectly formed, or from those that open late in the season. Probably the first and second pickings furnish the most desirable seed, if care is used not to pick from any of the small or poorly formed bolls. Owing to the danger of picking the cotton from small and imperfectly formed bolls, it is frequently recommended that the seed be saved from the second and third pickings, where four pickings are made.

18. What are the advantages claimed for mechanical cotton planting, over hand planting?

1st. Quicker than hand planting.
2d. More economical on seed.

3d. Gives better results, by planting more evenly.

The "cotton planter" is in general appearance similar to an ordinary wheel-barrow with a tube in the bottom for the seeds to fall through, while an arrangement for intermittent feeding is operated by a crank from the wheel. It also carries a tool for opening the soil, and also for covering the seeds with a thin layer of soil after they have been deposited into the bed.

19. There are two periods in the life of a cotton plant. What are they, and under what conditions does each produce the best results?

The first period in the life of the plant is that in which the stalk and plant generally are nourished; and covers about two months, or say from seed to flower which extends a little over that time; during this period the climate must be warm with a moist atmosphere, while the general cultivation of the plant must also be attended to, and cleared of such foreign growth as would tend to rob the plant of its nourishment.

The second period is known as the fruiting period and during this time more attention must be given to producing lint and seed. This period extends from flower to picking season, and depends principally upon the ripening effect of the sun, as all cultivation ceases and the ground is allowed to dry, in order to check further growth of stalk.

20. What is meant by "chopping out" and at what period in the life of the plant or crop does it take place?

"Chopping out" is the term used in connection with the operation of cutting away the inferior or weak plants, and permitttng the more promising ones to remain. This is done when the plants are young (usually after about fourteen days growth), and according to location may be performed in April or May.

The distance between the plants after "chopping out" depends upon the nature of the plant and character of the soil; for instance two or three feet may be left between plants which attain a height of from six to 10 feet, while on smaller varieties a distance of from eight to fifteen inches is left.

On fairly good soil in the Carolinas the distance is from eighteen to twenty-four inches usually.

21. What length of time expires between the seeds being sown, and the cotton being ready to pick?

The length of time between the sowing of the seed, and the appearance of the plant above the ground may vary from 4 days to 2 weeks, according to the conditions of the weather.

Another 40 days is taken before the appearance of the bud, and from 3 to 4 weeks from bud to flower. The flower falls on the third day, leaving a tiny boll which requires an-

other 7 or 8 weeks to develop and burst; the whole covering a period of about 4 1/2 months.

22. What months constitute the picking season in the United States?

The first bale of the new crop generally comes from Texas, and in this State they may commence picking in July.

In other states August is usually considered early enough to give as the commencement of the picking season, which extends through September, October, November and into December; according to location and conditions under which it has been grown.

23. Why is it that cotton is seldom picked early in the morning and never in the rain?

The reason for the above is, if cotton is picked while wet with either dew or rain, it will after being stored a short time become mildewed or rot.

24. Describe briefly a year's work on a cotton plantation.

January, breaking up.

February, bedding up and broadcast fertilizing.

March, bedding up and fertilizing in drills.

April, sowing and chopping out.

May, chopping out and general cultivation.

June, during this month the farmers are kept busy in general cultivation, such as keeping the soil moist and broken up.

July, this month the crop is said to be "laid by" and is the period for maturing the fibre.

August, September, October, November and December, picking.

25. To what would you attribute an excessive amount of broken leaf and stalk mixed amongst the cotton?

The above may be attributed to carelessness during picking, and may be done by the pickers grasping the leaf and crushing it into small particles while taking the cotton from the pod; or again, it may be by dropping a large amount of cotton on the ground and gathering same in a careless manner. A large per cent. of leaf, etc., could be thus mixed with the fibres.

26. What country is supposed to be the home of cotton plant?

When and where cotton was first cultivated seems to vary considerable with different writers of the History of Cotton. There is, however, one country which seems to have the claim in this direction; viz., India.

It is said that this country produced woven fabrics 4,000 years ago, this being based upon references from Hindoo religious works, which refer to "threads in the loom," and other such indications to bear out the above.

27. Give a list of the principal cottons manufactured in the United States.

The following list of cottons and their adaptability for different counts of yarn are

given as representing the principal varieties used in the United States.

Cotton.	Length in inches.	Counts Warp.	Counts Filling.
Selected Sea Island	1¾ to 2¼	200	300
Commercial or Ordinary Sea Island, and Florida Sea Island	1¾ to 2	150	250
Georgia Sea Island	1½ to 1⅞	120	200
Egyptian	1¼ to 1½	70	120
Allenseed	1¼ to 1½	70	120
Peelers	1¼ to 1⅜	60	80
Gulf Cotton or Orleans and Benders	1 1/16 to 1¼	40	60
Uplands and Memphis	1 inch	30	40
Texas	⅞ to 1 inch	25	35

Rough Peruvian is also used in the United States (see question 44).

28. What is the name and grades of the best cotton and where is it grown?

It is generally acknowledged that the Sea Island cotton (grown on the islands adjacent to the coasts of Florida, Georgia, and the Carolinas, and also to some extent on the mainland) is the best cotton grown.

It has a fibre which is long, fine, silky, and uniform in diameter; the latter being about 1/1560 part of an inch, and the length ranging from 1 3/8 to 2 1/4 inches.

It may be spun into the finest yarns up to 300's or more.

P. S.:—300's equals 300 hanks in one pound; therefore as one hank is 840 yards, there would be 840 x 300, or 252,000 yards in one pound.

The grades of Sea Island cotton are as follows, beginning with the best:

Extra fine,
Fine,
Medium fine,
Good medium,
Medium,
Common,
Ordinary.

29. What is meant by the term American cotton?

American cotton is the term used to represent practically all the varieties and classes of cotton grown in the United States except Sea Island cotton; and while this is grown in the States it is considered as a separate class, and has a special standard of grading. American cotton includes a large number of varieties, but all may be placed under one of the following general classes.

Long Staple Uplands, Gulf Cottons, Ordinary Uplands, and Texas Cottons. The length of the staple varies from 7/8 to 1 1/6 inches in the Upland and Texas varieties, and from 1 1/16 to 1 1/4 inches in the Gulf cottons, and from 1 1/4 to 1 5/8 inches in the long stapled Upland.

The class of yarn which can be made from the above will range from 10 to 30 in the Texas and Upland, while up to 50 may be made from the Gulf cottons and from 50 to 120 from the Long-stapled Uplands, which include such cottons as Allen-seed, Peelers, etc.

30. What is meant by Long-stapled Uplands? Name a few leading varieties, and their principal characteristics?

FIG. 2. OPEN BOLL OF LONG STAPLE UPLAND COTTON (ALLEN IMPROVED).

(By permission U. S. Dept. Agriculture, from plates in Year Book, 1903.)

Long-stapled Uplands is the name being used to represent cottons which have a

longer and finer fibre than the ordinary Uplands, which may be the result of careful selection and cultivation, or the natural properties of the soil, together with favorable atmos-

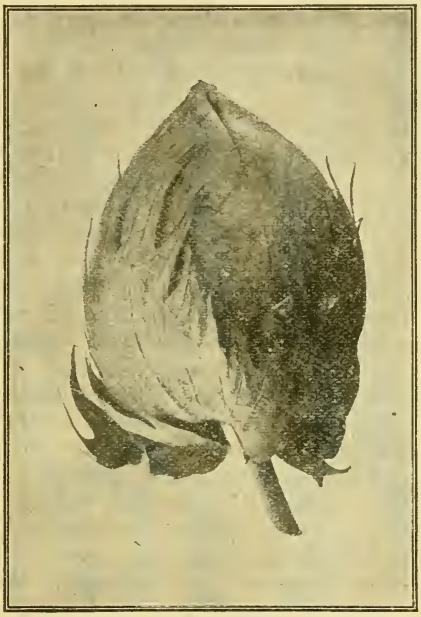

FIG. 2. UNOPENED BOLL OF LONG STAPLE UPLAND COTTON.
(By permission U. S. Dept. Agriculture, from plates in Year Book, 1903.)

pheric conditions, or a combination of the above.

One of the first and most common of this class is the well known "Peeler Cotton."

which had its origin in Warren Country, Mississippi about 1864. This cotton is used extensively for hosiery yarns up to 50 or 60 counts, and has a staple of about 1 1/4 inches.

Another popular class is the "Allen cottons," which include three or four varieties; viz., The Allen Long-staple, Allen Yellow Bloom, Allen Hybrid, and Allen Improved. (See Fig. 2.)

The above cottons are the result of careful and scientific cultivation on the part of Mr. J. B. Allen of Port Gibson, Miss., and are now the most popular American varieties for fine spinning. Much of Allen cotton will range from 1 1/4 to 1 1/2 inches in staple, and is exceptionally white and silky, with reasonable amount of strength. This class of cotton is used in many mills for combed yarns up to 120 filling, and about 70 or 80 warp.

Another variety having general manufacturing characteristics much similar to the Allen cottons with the exception of uniformity, is known as Griffin cotton, and obtains its name from John Griffin of Greenville, Miss.

There are several others of more or less importance, which, by name are scarcely known in the manufacturing centres, except under the general term of long-staple American.

31. What is meant by "Gulf Cotton?"

Gulf cotton is supposed to represent certain varieties grown in the vicinity of the Mississippi River, and shipped from ports on the Gulf of Mexico.

Owing to the fact that a large amount of

this cotton is shipped from New Orleans, it is referred to in some cases as Orleans cotton.

It will be in order at this point to state that the name may have some connection with the following taken from "Cotton Culture" by Lyman.

"A number of planters in Southern Mississippi near where Rodney now stands, were amongst the first, if not the first, to pay attention to the improvement of cotton seed. They produced an excellent quality which was much in demand in the South. Their bags were marked 'Petit Gulf,' the name of a small shipping point on the river where an eddy in the stream made a little bay or gulf. From this circumstance the seed was universally known as 'Petit Gulf' or 'Gulf-seed,' and under that name has been extensively used in the South."

It may be safely stated that Gulf Cotton represents a medium between the long-stapled and ordinary Uplands; being the natural product of the alluvial delta region of the States of Mississippi and Louisiana, which through the richness of the soil will produce a cotton with 1 1/8 to 1 1/4 inch fibre, with scarcely any artificial fertilization.

"Benders" cotton, which receives its name from being cultivated around the bends of the Mississippi River, is one of the better classes of Gulf Cotton.

32. What is meant by "Upland Cotton" and "Texas Cotton?"

The above name is given to one of the

American varieties, grown on the rising lands of Virginia, North and South Carolina, Georgia, Alabama, and in some sections of Tennessee and Arkansas.

It is a soft, fairly clean cotton of good commercial value, and can be made into good filling yarn up to 40's or 45's, but when made into warp yarn it is most suitable for numbers up to 30.

The length of the fibre will vary from 7/8 to 1 1/16 inches.

This class of cotton represents the bulk of the American crop, and is fairly clean, while it is adapted for a wide range of domestic uses, which makes it a good commercial cotton.

Texas cotton refers to cotton grown in the State of Texas, and while shorter than the Uplands as described above, its general characteristics are somewhat similar, except that about 30 yarn is as high as it will produce with satisfaction.

33. Into how many grades may American Cotton be classified; which grade is the basis for quotations, and how do the rest vary?

American Cotton may be classified into the following:

Full, Half, and Quarter Grades.

Full Grades.	Half Grades.	Quarter Grades.
Fair		
		Barely Fair
	Strict Middling Fair	
		Fully Middling Fair
Middling Fair		

Barely Middling Fair
Strict Good Middling
Fully Good Middling
Good Middling
Barely Good Middling
Strict Middling
Fully Middling
Middling
Barely Middling
Strict Low Middling
Fully Low Middling
Low Middling
Barely Low Middling
Strict Good Ordinary
Fully Good Ordinary
Good Ordinary
Barely Good Ordinary
Strict Ordinary
Ordinary

In addition to the foregoing grades, a special grade is set upon cotton having what is known as "bloom" or "tinge," which indicates fibres having extra lustre; but as a rule they are usually weaker than the ordinary staple, of the same variety. Stained cotton indicates cotton which has been stained by rain, sand, etc., and this also is quoted at a different price than the same grade of ordinary or regular cotton. See the following list:

The New York contract calls for about 100 bales of American cotton in the usual square form (round bales not available), weighing not less than 49,500 pounds and not more than 50,500 pounds.

The quoted price is for **Middling** and the other grades are allowed for, on or off, as per

following table. A point equals 1/100 of a cent.

Fair	130	points	on.
Strict Middling Fair	113	"	"
Middling Fair	96	"	"
Barely Middling Fair	79	"	"
Strict Good Middling	62	"	"
Fully Good Middling	53	"	"
Good Middling	44	"	"
Barely Good Middling	33	"	"
Strict Middling	22	"	"
Fully Middling	11	"	"
Middling	basis.		
Barely Middling	7	"	off.
Strict Low Middling	14	"	"
Fully Low Middling	26	"	"
Low Middling	38	"	"
Barely Low Middling	55	"	"
Strict Good Ordinary	72	"	"
Fully Good Ordinary	86	"	"
Good Ordinary	100	"	"
Strict Good Middling, tinged	30	"	on.
Good Middling, tinged	value of Middling.		
Strict Middling, tinged	6	points	off.
Middling, tinged	12	"	"
Strict Low Middling, tinged	34	"	"
Fully Middling, stained	42	"	"
Middling, stained	50	"	"
Barely Middling, stained	78	"	"
Strict Low Middling stained	106	"	"
Fully Low Middling, stained	128	"	"
Low Middling, stained	150	"	"

If warranted, allowances for extra staple are made, varying from 1/16 to 1/4 cent per pound.

34. What is meant by the terms "Spot," "Futures," and "C. I. F. & 6 per cent." as applied to cotton?

"Spot" cotton means cotton which is act-

ually on the market at time of purchase, and may be bought from broker's samples.

"Futures" means cotton which may be bought for delivery at some future time, say 3 or 4 months from day of purchase. This system is resorted to by many as a means of speculation, although not less than 100 bales can be bought on this basis.

"C. I. F. & 6 per cent." means that the seller must pay all "costs, insurance and freight" until cotton is received by purchaser in port of delivery, also that 6 per cent. is allowed for tare including bagging and ties.

35. Upon what terms is "Spot" cotton sold in the United States?

Cotton is sold in the United States by gross weight.

The purchaser pays the bill usually within 24 hours after delivery of cotton, which he is obliged to take within 10 days of purchase, or he can demand its delivery at any time within 10 days of purchase.

While no allowance is made for the bagging and ties (which on an average bale will represent about 6 per cent., or from 24 to 28 lbs. loss in tare), there is a reduction made of from 1/2 to 1 cent per lb. from standard price for all bales below 350 lbs.

The above rebatement is given, owing to the fact that while the total weight of the bale may come below 350 lbs., the weight of bagging and ties will be practically the same as it would be for a 400 or 500 lb. bale, causing the per cent. of tare to be considerably greater.

Again the shippng rate is greater per lb. with light bales, as the number of bales forms the basis on which the price is quoted.

36. Give a brief outline of the New York and New Orleans "Contract for Futures."

The following is from A. B. Shepperson's "Cotton Facts."

The New York Contract

is for 50,000 lbs. (gross) in about 100 bales cotton, growth of the United States, to be delivered from licensed warehouses in the port of New York during the month agreed. The delivery to be at seller's option upon 5 days' notice to buyer, and from one warehouse.

The cotton to be of any grade, from Good, Ordinary to Fair, inclusive, and if stained, not below Low Middling.

Price to be for Middling, with additions or deductions for other grades according to the rates of the Cotton Exchange existing on the afternoon of the day previous to the date of the notice of delivery. Certificates of inspection, classification, and weights issued by the "Inspector-in-Chief of Cotton" of New York Cotton Exchange, to be tendered with the cotton and made the basis of settlement.

Payment to be made upon the dav of delivery of warehouse receipts for the cotton.

Either party to have the right to call for margin, as the variations of the market for like deliveries may warrant. An original margin up to $5 per bale, to remain in Trust Company until settlement of the contract may be re-

quired by either party, provided demand therefor is made within 24 hours after the transaction. The party demanding original margin must also deposit an equal amount himself. All margins are required to be deposited in a Trust Company or Bank.

The New Orleans Contract

differs from the New York Contract only in the following particulars, viz.:

It is not required that the cotton should be classed and weighed under the auspices of the Cotton Exchange.

When an original margin of $5 per bale has been deposited, the margins for variations in the market are paid directly to the party in whose favor the market turns.

37. What position does Egypt hold as a cotton producing country?

Egypt as regards quantity ranks about fourth; being preceded by the United States, India and China.

As regards quality it ranks next to the Sea Island varieties.

The cultivation of cotton in Egypt is being extended considerable by means of irrigation works, but the delta of the Nile furnishes the bulk of the crop.

The commercial value of Egyptian cotton is higher than the average American variety, owing to its special adaptability for hosiery and underwear, also for fine cotton goods. It is also fairly even running in length, and is one of the most economical cottons used for

combed yarns, and ranks amongst the best for mercerizing and mixing with silk.

38. Name some of the principal varieties of Egyptian cotton.

It was formerly the custom to divide the Egyptian cotton crop into three general varieties, known as Gallini, Brown and White. The former was grown from Sea Island and resembled it in many ways. It is, however, being replaced by other varieties, and is now only cultivated in small quantities.

The Brown variety has also undergone changes, and is now subdivided into several varieties, each varying in some particular characteristic from the other.

The leading Egyptian varieties now being cultivated include:

Mitafifi which is the controlling factor for the Egyptian market, and forms about 75 per cent. of the entire crop. It is of a rich yellowish brown color, long, fine and fairly strong, and is grown in the Delta of the Nile.

ASHMOUNI
HAMOULI
ABBASI — General characteristics much like MITAFIFI, but not so deep brown, and not quite so strong.

ABIAD
TIFTAWI
BAMIA — Shorter, fibre of lighter brown, and not so strong as the varieties previously mentioned.

Yannovitch and **Taffiri** are also varieties of Egyptian cotton which have excellent properties, and may be classed next to Mitafifi.

Egyptian cotton will range from 1 1/4 to

1 1/2 inches, and may be spun into yarns up to 120's.

39. Name the grades of Egyptian cotton beginning with the best.

Extra fine.
Fine.
Good.
Fully Good Fair.
Good Fair.
Fair.
Middling Fair.
Middling.

40. What position does India hold as a cotton producing country; 1st for quantity and 2d for quality?

India ranks next to the United States as a cotton producing country so far as quantity is concerned, but in quality its product is in the lowest class.

The general make up of Indian cotton is short, harsh, and dirty, but reasonably strong.

The length of the staple scarcely averages one inch, and is made in yarns up to 25's, although the greater per cent. of the crop is only suitable for yarns from 5's to 15's.

41. India's cotton producing territory is divided into sections. How many are there principally, and what is the character of the cotton from each?

The principal sections are:

Ganges Valley, Deccan, Western India, and Southern India.

The cotton from the Valley of the Ganges is possibly, though short stapled, the oldest cotton known to the manufacturing world; and, as formerly, is all practically used in the neighborhood of its cultivation.

The cotton from the Deccan or Central India, is the best Indian cotton, and is the chief section for the cultivation of export cotton; the staple is about 7/8 to 1 inch, and can be used for yarns up to 20's warp, and 30's filling.

The cotton from Western India is about 3/4 inch long, and will spin up to 15's.

Southern India produces some of the best Indian cotton, comparing somewhat similar to those from the Deccan, so far as length and adaptability are concerned.

Indian cotton generally, through all its varieties, is short and dirty; this is probably due to careless cultivation and poor ginning, together with the unfavorable climatic conditions.

42. Give the name of a few Indian varieties with approximate length of fibres, and the counts of yarn for which they are adapted.

Hingunghat, 7/8 to 1 in., dirty but strong; yarn to 30.

Oomrawattee or **Oomras,** 7/8 in., dirty; yarn to 25.

Bhownuggar, 7/8 to 1 in., compares favorably with Hingunghat.

Tinnevelly, 7/8 to 1 in., fairly clean and strong; yarn to 25.

Broach, 7/8 in., darker and a little cleaner than Hingunghat; up to 28.

Dollerah, 7/8 in., whitish but dirty and not very strong; up to 25.

Comptah, 3/4 to 7/8 in., weak and dirty; yarns up to 20.

Dharwar, 3/4 in., cleaner than Comptah; yarns up to 20.

Scinde, 5/8 to 3/4 in., white and fairly clean; yarns up to 12.

Bengal, 5/8 in., harsh, dirty, fairly strong; yarns up to 12.

Cocoanada, 5/8 in., reddish brown color and weak; yarns up to 12.

43. Name the grades into which Indian (East) cotton may be classified.

East Indian is graded as follows; the order given representing from highest to lowest grade.

Superfine.
Fine.
Fully Good.
Good.
Fully Good Fair.
Good Fair.
Fully Fair.

44. Give a general description of the cotton grown in South America.

The South American cottons include the Brazilian and Peruvian varieties, which are the only ones of any importance, although there is a small quantity grown in the Argen-

tine Republic, and in British and French Guiana.

The Brazilian cotton is usually even running throughout its varieties; the fibre is harsh and wiry, but clean and strong; its length averages about 1 1/8 in. and will produce good warp yarn up to 40's or 50's, and filling yarn up to 60's, while the better classes may be used up to 70's.

The following are amongst the leading varieties:

Maranhams, Pernam, Pariaba, Ceara, Bahia, and Maceio.

The Peruvian varieties are divided into three principal classes, viz.:

Peruvian Sea Island, which has a long and fairly strong fibre, but not so silky and clean as Sea Island proper. The length of the fibre is about 1 1/2 in. and will produce yarns up to 100's.

In addition to the above are Rough and Smooth Peruvian. These have approximately the same average length of staple, viz.: about 1 1/4 in. and each is capable of being made into yarns up to 60's or 70's.

Rough Peruvian, however, is harsh and wiry, fairly strong, but very clean. There is over 20,000 bales used annually in the United States, of which (according to the eminent authority of A. B. Shepperson) not a single bale is used except for mixing with wool.

"Rough Peruvian Cotton (so called, to distinguish it from a fine grade of cotton grown in Peru, but which never comes to this country), has a strong, rough, woolly, crinkly

staple, about 1 3/8 to 1 1/2 inches long. As it is of the 'tree cotton' variety (such as grows in Brazil), it is entirely free from sand or dust, and is usually very clean and well handled. The loss in carding does not exceed 2 per cent., and the loss in spinning, owing to the length and strength of staple, is very trifling. It is called 'vegetable wool,' and when carded its resemblance is so close and its characteristics so strikingly similar to wool, that it could readily be sold as wool, even to a dealer. When woven into goods along with wool the cotton fibres cannot be determined with any certainty except by using chemical tests. This cotton is sold exclusively to manufacturers of woolen goods for the purpose of mixing with wool in the manufacture of underwear, hosiery and cloths which are sold by retail dealers as being made entirely of wool."

Smooth Peruvian is about the same length, and can be spun into practically the same counts of yarn, but is softer, smoother and more pliable than Rough Peruvian.

45. Name the grades into which Brazilian Cotton may be classified.

Good Fair, Fair and Middling Fair are the most common grades, but a more complete list will include:

Fine.
Good.
Good Fair.
Fair.
Middling Fair.
Middling.

The above order represents highest to lowest grades.

46. Give a brief description of the cotton grown in Mexico.

Over one-half of the Mexican cotton crop is produced in the state of Coahuila and is practically all used in Mexico.

The general run of this cotton has a white, clean, and fairly strong and wiry fibre, with a staple of about one inch. It can be spun up to 30 warp, and when mixed with Uplands will produce a yarn having a little more strength than a yarn made entirely of Uplands.

The average weight per bale is about the same as the standard American bale, viz., 500 lbs.

47. Is there much cotton grown in China, if so, where is it manufactured?

The cotton production of China is estimated at about 1 1/4 to 1 1/2 million bales, and is all manufactured in the Chinese Empire and Japan.

The cotton is white, clean, but harsh and wiry, and can be mixed with wool. The fibre while being reasonably strong is not long enough for fine yarns; the length of the staple may average about 3/4 of an inch.

Cotton is also grown in Japan and Corea, and while it may be said to resemble the Chinese varieties, the exact amount cultivated is not known, but the entire crop is used in the above countries.

48. What is the cause of Asiatic cotton being of such poor quality generally?

It is well known that the cotton grown in Asia is generally a short, coarse and low grade. The reason for this is attributed principally to the climate. For instance India is the most important cotton producing country in Asia, and its climate is so hot and dry that the plant does not receive the nourishment which it needs, and this together with unskilled, careless cultivation places Indian cotton amongst the poorest class.

They are used for very coarse yarns, and also for mixing with waste from better classes of cotton.

Other Asiatic countries may produce a little better cotton than India, but the general statement referring to careless cultivation applies more or less to all.

49. What are the principal points to be observed in selecting cotton, and how would you proceed to judge a sample of cotton?

When it is necessary to produce a cotton yarn of certain characteristics, the selection of cotton should receive careful attention on the part of mill managers entrusted with the duty of purchasing the raw material.

It is customary in many mills to employ "cotton samplers," whose duty is to examine samples from every bale, and if necessary, form groups of certain bales having special features, or report on bales falling below the grade or standard which the sample is supposed to represent.

In case of the latter, a rebate may sometimes be obtained, while in the case of the former the bales are used for special purposes.

In addition to the price, the following points must be considered:

1st. Length of staple.

2. Grade or general appearance of cotton in respect to freedom from sand, leaf, seed, moisture, or other impurities which may increase the loss per cent. in working.

3d. Strength and color of fibre. (The former is more important in cotton intended for warp yarn, thread, lace, etc., than in cotton intended for filling or hosiery yarn. The color is not so important for goods which are to be dyed or printed.)

4th. See if there is much variation in the samples, or whether they are even running in length, cleanliness, moisture, etc.

When examining the samples (which are guaranteed to be a fair representation of the bale from which they have been taken) it is customary to first note the comparison in color; then to take the samples in turn and after slightly opening them, shake out as much sand, etc., as possible, to ascertain the loss from this source. To do this thoroughly, samples are sometimes passed through the pickers and cards; the percentage being more reliable when found in this way.

To determine the length of the staple, a number of fibres are gradually worked into a parallel condition, and afterwards a small tuft is extracted, and measured. This operation is performed by taking a handful of cotton, and

while holding it fairly firm with one hand, the tuft is broken by the other hand, and the loose fibres gently removed; then a number of fibres are gripped by the fore finger and thumb, and drawn gradually out of the bulk. It requires considerable practice to perform the above rapidly, but an experienced sampler can almost tell at a glance the length of the staple from a small tuft of cotton drawn out in the above manner.

With reference to the moisture, it may be mentioned that "testing ovens" are sometimes used to find the per cent. of moisture from small samples. This is done by subjecting the cotton to a radiated heat of about 180 deg. F. for one or two hours, and the per cent. is then calculated on the loss in weight. Another method is to break about 50 lbs. of cotton in small bunches, and after placing it in a basket, or box with either perforated or lath sides, expose same in a warm room for several days.

It has been found that a certain amount of moisture is necessary for the proper manipulation of the fibre, and a standard of 8 1/2 per cent. is usually allowed.

50. Name at least six of the world's important markets outside of the United States.

Excluding the markets of the United States the following will represent the most important markets for raw cotton:

Liverpool (England) supplies practically all the trade of the British Isles and also exports certain varieties of cotton to other countries.

Bombay (India) is the leading market for

Indian cotton, and supplies a good proportion of the trade of that country. There are, however, two other ports which may be taken into account when considering the distribution of Indian cotton, these are Calcutta in the Bengal Presidency, and Madras in the Madras Presidency.

Havre (France) on the Seine, is the most important cotton market from which the manufacturers of France are supplied.

Bremen (Germany) supplies the trade of that country which is chiefly for American and Indian cotton.

Amsterdam supplies Holland.

Genoa and Milan are the cities through which the Italian trade is supplied.

51. Name some of the uses of cotton in addition to cotton cloth.

In addition to cloth, cotton may be used as a fibre for any of the following purposes:

Sewing thread, lace, rope, hosiery, twine, netting, webbing, batting, tape, bagging, and many other purposes of a kindred character.

Again departures from the above line may be mentioned where the cotton fibre has been utilized.

If cotton is immersed in Sulphuric Acid (3 parts) and Nitric Acid (one part) then washed and dried, we obtain (pyroxylin) gun-cotton.

Dissolve gun-cotton in ether, and we may produce collodion.

A mixture of collodion and potassium iodide when spread on glass and then dipped in a so-

lution of silver nitrate, produces the plates used for photography.

Celluloid is made from gun-cotton and camphor.

If cotton fibres are treated with concentrated Sulphuric Acid they swell and form a gelatinous mass, and an addition of water causes a precipitate to be formed called amyloid, which is used in making parchment.

52. Is the fibre the only portion of the cotton plant which can be used for commercial purposes?

The fibre is not the only portion of the plant which may be used as the following will show the importance of other portions of the plant:

In the first place the seeds must be used for replanting, but as only a small proportion are necessary for this purpose, the remainder are used for producing cotton seed oil, and cotton seed meal.

The former is used for soap, miner's oil, cottolene, oleomargarine, and as a substitute for olive oil when refined, and in the crude state is used for dyeing.

The latter, viz.: cotton seed meal is used as cattle food or as fertilizer.

The following represents the approximate product of one ton of cotton seeds:

1,090 lbs. of meal or meat and 890 lbs. of hulls. The meat will yield about 300 lbs. of oil and 790 lbs. of cake.

There will also be about 20 lbs. of short fibres known as linters taken from the seeds.

The roots and bark are now being used for medical purposes.

53. When the cotton is picked from the plant the fibres are connected to the seeds; what would be the proportion of seed to fibre in 100 lbs. of "seed cotton?"

An approximate proportion would be 66 lbs. of seed and the remainder would represent fibre; as the seed usually equals about 2/3 of the total weight of "seed cotton." The latter is the name given to cotton as picked from the plant.

54. Is the cotton subjected to any mechanical treatment before being baled; if so, what is the object of the process?

As previously stated in 53, seed cotton is composed of about 2/3 seed; and as the fibres are secured to these at one end, it becomes necessary to separate them before the cotton can be worked.

The operation of separating them is known as **Ginning**, and the machine is known as

The Cotton Gin.

There are several reasons for performing the above before the cotton is baled, one of the principal ones being, that if the bales were pressed before the seeds were extracted, the oil from the seed would stain the fibres, and reduce their commercial value; again, the oil would be wasted, the seeds ruined, and the freight would be excessive, while the seeds

would finally have to be returned to the farmers to sow for the next crop.

The invention of the cotton gin by Eli Whitney, in 1793, completely revolutionized the cotton industry of the United States.

During that year the total exports were but 975 bales. The year following the invention the total exports were 3,200 bales. As stated in the Census report this increase so frightened one of the Southern planters that he exclaimed:

"I have done with the cultivation of cotton; there is enough in that gin-house to make stockings for all the people of America."

55. What is the most universal method of ginning American cotton? Is the method a defective one or not?

Practically the whole of the American cotton crop is ginned on what is known as the "saw gin" which obtains its name from the fact that the fibres are torn from the seeds by a series of circular saws, having a portion of their circumference enter a box containing the seed cotton, and after gripping the fibres the teeth of the saws pass through a grid which is set to prevent the passage of the seeds, and the result is that the fibres are torn away from the seed. See Fig. 3.

While this method is acknowledged to be defective, on account of the saws having a tendency to cut the fibres, its range of production causes it to be used in preference to other methods in which quantity is sacrificed for quality.

The high speed at which some saw gins are run, and the saws being too sharp or rubbing against the grid, also tend to aggravate the injurious method.

It will be in order to mention that no gin

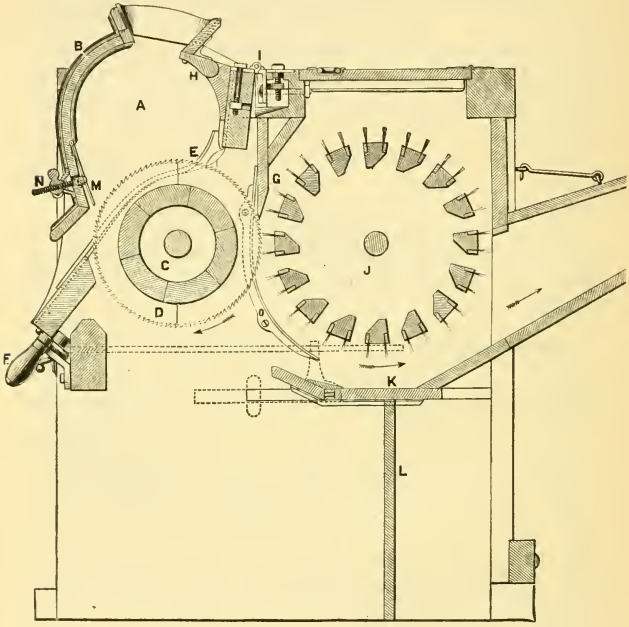

FIG. 3. SECTION OF SAW GIN.

now in use can separate seed from fibre without the slightest injury to either; but, the one approaching nearest to these results, and maintaining production is the best.

56. Give a general description of the saw gin, and the passage of the cotton through the machine.

To assist in making the answer more clear, reference will be made to Fig. 3, which represents the section of a gin built by the Eagle Gin Co. of Bridgewater, Mass.

The cotton is fed to the machine at A, and falls onto the teeth of the saws D, which are projecting into the receptacle A, between the grate bars shown at E. The saws may be 10 or 12 inches in diameter, and are threaded onto a cylinder which may accommodate from 40 to 80 saws, usually advancing by sections of 5 saws each.

The saws revolve at from 300 to 500 R. P. M. and are continually passing through the cotton in such a manner that the fibres are gripped by the teeth of the saws and are carried around with them, until the seeds to which they are attached come into contact with the grid E; this arrests the seeds and causes the fibres to be torn away by the saws and carried around until they are removed by the revolving brush J; which is set so that the bristles touch the fibres, and owing to the surface speed being higher than that of the saws, the fibres are taken off the saws.

The brush J will also create an air current sufficient to throw the cotton into the trunk which commences at K, although an additional air current is usually introduced to assist in this.

When a number of gins are placed together they are termed a battery, and the cotton from

all is deposited at some convenient place for baling, by means of flues and fans.

After the seeds have been stripped of the fibre, they slide or roll out of the box at M, and fall either into bags, or boxes placed to receive them.

The receptacle A together with the grate E and the cover B are practically one box which is hinged to the rest of the machine at I, and can be raised by lifting the handle F. This is used to prevent fire or accident when any hard substance falls into contact with the saws; as the raising of the handle F will lift the cotton out of contact with the saws.

The space through which the seeds are allowed to fall can be adjusted by means of the plate M which is in turn regulated by the adjusting screw N.

Feeders are also applied to give a uniform feed to the gin, and so arranged that they can be changed or stopped independently. The cost of a saw gin is from $3.00 to $4.00 per saw, with an additional $70 for feeder. The floor space required is about 7 x 10 feet; when using feeder and condenser with a 70 saw gin, the production will be about 500 lbs. or 1 bale per hour.

57. What is the average production of the Saw Gin?

The production of a saw gin is usually estimated at about 11 lbs. per saw per hour; this will represent about 4,400 lbs. from a 40 saw gin running 10 hours.

A saw gin may contain any number of saws

up to 80; although 50 to 70 will possibly represent the average range of sizes, and an average of 1 bale per hour will represent the approximate production.

58. Has any attempt been made to furnish a substitute for the saw gin?

Yes. It has been the aim of inventors for some time to place a gin on the market which will produce the same amount as the saw gin without the attendant evils. As a result there are several gins now on the market each differing in some detail from the others.

The name under which almost all the rivals of the "Saw gin" are classed, is "Roller Gins;" indicating the essential feature of the machine by which the separation of the fibres and seeds is effected.

The saw gin, however, has the advantage of a large production, and therefore for handling the large American cotton crop, no other gin has yet been able to supersede it.

59. It is claimed that American cotton has deteriorated in its commercial value; what are the causes to which this is attributed?

The deterioration of American cotton is attributed generally to poor ginning and baling, and careless handling and preparation for the market.

It has been stated by one authority, viz., Mr. Edward Atkinson, that about $30,000,000 are wasted in the South every year on account of unskilled manipulation of the cotton in its earlier stages.

The saw gin is also held accountable for a large amount of damage done to the American cotton crop.

Another important point in this problem is the fact that the bulk of the American crop is cultivated on small farms, and as the cotton plant yields to soil conditions so readily, it is assumed that the cotton from these farms cannot always be alike, although they may be sold and even classed as one lot.

A certain amount of care should also be exercised in picking the cotton from the plant, but owing to the fact that cotton pickers are paid by weight, it is not surprising to find them throwing pieces of boll, leaf and other impurities into the cotton to add weight.

At the ginneries also, the artificial adulteration has been practiced to the extent of adding sand, water, etc., to increase the weight of the bale.

It must not be concluded from the above that any cotton is absolutely free from seed, leaf, stringy or short fibre, because the most careful cotton pickers are not perfect and it is an easy matter to grasp occasionally a decayed leaf with the cotton. This will crumble into small pieces and after once becoming mixed amongst the fibres is difficult to get rid of afterwards.

Again there is always a certain amount of immature fibre in all cotton, and they are so weak that they break into pieces before they can be separated from the seed even with the most delicate ginning.

Baling the cotton does not materially dam-

age the cotton as a fibre, but the poor covering used and rough handling results in the cotton becoming "country damaged."

60. Name some of the principal defects found in cotton on its arrival at the Northern or European cotton mills.

In addition to the dilapidated condition of the bale itself there are several defects may be found in cotton such as unripe fibres, sand, leaf and stalk, and fibres which have been stained while on the plant.

The cause of these may be given briefly as follows:

Unripe fibres may be the result of unfavorable weather conditions during cultivation, neglect during cultivation, and poor soil.

Leaf, sand, stalk, etc., are the result of carelessness during picking, or by wind and sand storms passing during the period when the bolls are open.

It may be mentioned that it has been a source of wilful adulteration to insert a pailful of sand or water into the centre of the bale at the ginnery, in order to produce weight.

With reference to the stained fibres, this may be from the presence of coloring matter in some foreign substance such as seeds, pods, etc., which is crushed out while ginning, and stains the surrounding fibres. Another cause of stain is by allowing cotton to stay on the open pod during rainy weather, and if this is immediately after a few hot dry days, the cotton will become stained by what is termed "Rust."

61. What was the method of packing cotton prior to baling?

Prior to baling it was customary to pack the cotton in bags. These were filled by being suspended beneath a hole in the floor of the gin house, and the cotton dropped into it until almost full, then the bag was cut loose and the top sewed up.

62. State briefly the weight and dimensions of American Cotton Bales.

The weight of American Cotton Bales is supposed to be 500 lbs. and its dimensions 54 x 27 x 16 inches.

The above, however, vary greatly, some bales being as light as 350 lbs. while others will reach 750 lbs.

The bagging and "ties" or "hoops" usually amount to 20 or 25 lbs.

The light bales are an objectionable feature as shipping rates are quoted on the number of bales and if light bales are sent the price per pound is greater than a shipment of heavy bales. Again, owing to the uncertainty attached to the correct weighing of small bales and also to discourage the making of small bales, an allowance of one dollar per bale is allowed in favor of the buyer.

63. How do foreign bales compare with American bales in weight and general make up?

The American bale, speaking generally, is the worst looking bale which arrives in the mills of countries outside the United States,

while its condition on its arrival at the northern mills could be considerably improved.

The Egyptian bale is shorter, but is held by more ties than the American bale. The bagging is better and the cotton is well packed.

The Indian bale is in general appearance somewhat similar to the Egyptian bale, but instead of having a number of separate ties it is held by one spiral tie.

The Brazilian bales are lighter than almost all others except the Peruvian. This may be accounted for by the method of handling the cotton in South America, between the farmer and the merchant.

Kind of Cotton.	Style of Bale.	Dimensions of Bale.	Weight of Bale.
American ...	"Uncompressed" or "Gin Bale"	58"x40"x30"	about 500 lbs.
American....	"Compressed" or "Standard"	54"x27"x16"	" 500 "
American.. .	"Dedrick Bale"	24"x18"x28"	" 250 "
American....	"Round Lap Bale"	35" long, 22" dia.	" 280 "
American....	"Lowry Bale"	36" long, 18 dia.	" 250 "
Egyptian	"Compressed"	50"x30"x20"	" 730 "
Indian and Asiatic ...	"Compressed"	50"x20"x16"	" 400 "
Brazilian	"Compressed"	50"x20"x16"	" 250 "
Mexican	"Compressed"	53"x33"x46"	" 500 "
Peruvian ...	"Compressed"	40"x25"x20"	" 200 "

THE BALING OF AMERICAN COTTON.

In addition to the answers given to questions 62 and 63, it has been considered advisable to include the following article on the above subject.

Considerable interest has been taken recently in connection with the better marketing of the American cotton crop, and as the matter concerns both manufacturers and planters a satisfactory solution is still pending.

Manufacturers, especially abroad, are desirous of obtaining the American bale in better condition so far as the covering and binding are concerned, with a view of preventing loss of fibre, and also to obtain as compact a bale as possible to reduce cost on freight.

Planters are interested because they are looking for the cheapest method of marketing their cotton.

Several remedies are now before them in the shape of either cylindrical bales or an improved uniform square bale.

The most prominent defects are: first, the large variation of weight in the square bales, although the size may be practically the same; second, the coarse bagging or burlap, and the ties as used at present, do not protect the cotton sufficiently from becoming dirtied, lost, or in some cases stolen, as the rough handling to which it is subjected has a tendency to tear the covering.

In the first instance, variations of almost 300 lbs. have been known to exist in the weight

of square bales when delivered to the mill. This is also the case with bales apparently the same dimensions. If then the bales were packed in a form which will give the same density to the cotton and that be a standard say of 40 lbs. per cubic foot, it follows that the capacity of steamboats, or freight cars could be more fully utilized. This causes light bales to be objectionable, because the shipping rates are based on price per bale; therefore, if light bales are made, the shipping rate per pound will be greater than a shipment of the same number of heavier bales.

The above is partly remedied by the introduction of the square bale of uniform size and weight, which is now advocated by those who desire to improve the bale, but at the same time retain its shape, except that it will be reduced to 54 x 24 x 16 inches instead of 54 x 27 x 16 inches, and better covering used.

This method, however, will be neutralized considerably if no change is made in handling the bales when shipping. For instance, it is common practice to force the bales into the hold of the vessel by means of powerful screws; and as a result when they are to be unloaded the hooks have a tendency to tear the covering, thus wasting the cotton besides exposing the cotton to dirt, theft, and at times completely destroying the marks used for identification. This would as at present concern the American manufacturer more than the European, as an allowance is made to the latter for loss in weight, etc.

Another point in reference to the 54 x 24

uniform square bale, is that the planters are not very favorably impressed with the change for the following reason:

It is claimed that this bale will not contain as much cotton as the old style, by about 20 per cent.; therefore, assuming a farmer to have enough cotton to make say 10 bales of the old style, it would be necessary to make say 12 bales of the new style, costing the farmer almost $2.50 more to market the cotton in new bales than would be the case with the old ones, and at the same time obtain no return in the shape of better price for the cotton.

In the United States there are several forms in which the cotton can be received at the mill, some of which will be briefly referred to.

In the Southern States there are many mills which have a ginnery as part of their equipment, and after ginning, the cotton is conveyed to the mixing or feeding room of the mill. This saves the expense of bagging and ties, and the baling process.

Another method of receiving the cotton in the South generally, is in the form of a bale known as the "Gin bale." This is made at the gin and while its dimensions may vary considerably, a fair average is given as 30 x 40 x 58 inches, weighing about 12 lbs. per cubic foot; this bale is also known as the "Uncompressed Bale" as the only packing which it receives is at the ginnery by means of a "Screw" or "Hydraulic" press operating in a box which is usually situated at the end of a trunk or tube through which the cotton passes after leaving the gin proper. The box is con-

structed of wood rails generally, and the bagging is placed into position by the operator by lowering the sides of the box before the cotton is admitted.

When cotton is to be shipped a considerable distance the "Gin bale" is "compressed" by means of a powerful press reducing the dimensions to as near the standard as possible, viz.: 54 x 27 x 16 in. with a density of about 22 lbs. per cubic foot.

Both the "Gin bale" and "Compress bale" are usually covered with open mesh jute bagging, held in place by about 7 steel or iron bands about one inch wide, and secured by metal buckles. The covering and fastenings are known as the "bagging and ties" and on an ordinary American bale may weigh about 25 lbs.

The Round Lap Bale.

The above bale is made by the American Cotton Company and is a cylindrical bale, about 35 inches long, and 22 inches diam., being packed to about 37 lbs. per cubic foot. A bale weighing about 270 to 290 lbs.

This bale is formed by winding a continuous sheet (about 2 lbs. per yard) of cotton into a roll or lap, and while being formed it is subjected to the action of two powerful rolls which press it so firmly that no ties are used, and practically a self contained bale is produced.

Just before the bale is taken from the press a closely woven burlap covering is wrapped around it by being fed to the press during the

last revolution. This wraps the covering perfectly tight and the edges are sewn so that the entire bale is enclosed.

Below are a few of the advantages claimed for the "Round Lap Bale."

1st. A saving of covering, equal to almost 50 per cent.

2d. Saves the "compressing" charges.

Various local charges eliminated by the new bale aggregate at least 50 cents, and compressing averages another 50 cents. There is a large saving in transportation expense due to the fact that round lap bales, shipped through from gin houses, load to the full weight capacity of freight cars, instead of to about one-fourth the weight capacity, as in the case of uncompressed, and about one-half the weight capacity, as in the case of compressed square bales. There is another saving in fire insurance, due to the non-combustibility of the round bale. If for export, there is a saving at the dock in the cost of loading, round lap bales being easily handled and not needing to be "screwed" into the holds of vessels, which third compression costs shippers of square cotton from 25 to 40 cents per bale. There is a further saving in ocean freights and marine insurance charges owing again to the increased loading capacity of the bales, their lessened fire risk, and immunity from "country damage."

Another form of cylindrical cotton bale is made by the Planters Compress Co. and is known as the "Lowry Bale."

This obtains its name from the Lowry press,

on which the bale is formed. It is about 36 inches long, and 18 inches diameter. It is packed by feeding the cotton through slots at the top of the press. The bale is built endwise, and pressed to a density of about 47 lbs. per cubic foot; a full bale weighing about 250 lbs.

The latest method of securing the cotton in this bale is by passing two steel bands around the bale lengthwise, and fastening them by buckles, then a closely woven covering of burlap is drawn over the bale and tied at the end by a draw string, which causes a small portion of the cotton to be exposed at one end.

The floor space occupied by this press is about 10 x 6 ft.

HOPPER BALE BREAKER, SHOWING BALES ARRANGED FOR MIXING, AND MIXING BIN.
(By courtesy of Cosmopolitan Magazine.)

COTTON MIXING.

After the cotton arrives at the mill, it is customary to open up a number of bales and after pulling the cotton from its matted condition into comparatively small bunches, it is piled up into a stack and allowed to stand for a few days before being passed through the various processes of manufacture.

While the bales thus opened may be either of the same class, or of different classes, the operation is known as **Mixing.**

Cotton may be mixed in the mill for several reasons, and the following may be classed amongst the most important:

1st. To preserve the fibre by allowing the cotton to stand in a loose condition for several days, thus allowing it to expand and to be opened more easily in the cleaning processes.

2d. To allow any excess moisture to evaporate before passing it through the various machines.

3d. To permit a special quality of yarn to be obtained by mixing and blending different varieties of cotton.

The first and second reasons are important from the fact that, owing to the large crop of cotton being collected from so many different sources (principally from small farms), and the cotton plant yielding so readily to the varying conditions of soil and climate, we find there is considerable variation sometimes existing in cotton which is supposed to be of the same grade and staple.

Again in addition to this natural variation, there are others to be contended with, such as inefficient grading and handling, and artificial adulteration; the latter being resorted to at times in the form of sand and water, which is added in various quantities in order to produce weight.

The third is of importance, as by resorting to judicious blending or mixing of different varieties or grades, a yarn of required quality for different purposes may be economically produced. For instance, in large mills it is the practice to employ a person specially qualified, or have the superintendent examine every bale, and subdivide the stock into lots which may be worked as such, into yarns of various counts for special purposes.

There are certain points to be observed in mixing cotton, in order to obtain the best results amongst which may be included the following:

The length of the staple (fibres), color, strength and general characteristics of the cotton, and the price.

Referring to the length of the staple, it must be remembered that all cotton contains long and short fibres, but this variation is due to natural causes during growth, and it is the object of certain processes to separate the short and long fibres, and to eliminate the former. Thus a mixture of different varieties which are not of equal length as near as possible, is a practice which is detrimental to good and economical work.

When the process of drawing is reached it

will be seen how necessary it is to have the fibres in a given sliver as nearly as possible one length. Unless this is the case the setting of the rolls causes considerable trouble, as they cannot be set to accommodate two different lengths of staple at the same time. In twisting, also, the short fibres, not having the same grip of the adjoining ones as those of greater length, are not properly twisted in, and the result is that "cockled" and uneven yarn is produced.

In addition to the length of the fibres, a knowledge of the strength of different fibres will assist in selecting cotton for special purposes; for instance, cotton having a comparatively strong fibre may sometimes be mixed with a weaker one in order to increase the strength of the yarn for warp, while the weaker fibre could be used along for filling. It may be noted at this point that very harsh and wiry cotton would not work well with soft, pliable cotton, as the treatment adapted for one would not be suitable for the other; although, if the above characteristics were only present to a small degree and not very prominent in each case, it might be possible to use such a mixing and increase the strength of the yarn.

With reference to color, this point is not so important in yarns intended for prints, or where the finished product is to be dyed; but in fabrics either woven or knitted, where the natural color of the fibre is to be retained, it is essential that the mixing be composed of cotton as near as possible of one color. Other-

wise the fabrics would have either a shaded, or striped effect.

The most common method of making a mixing is to build the cotton up in the form of a stack which may be open, or enclosed in bins made with lattice sides so that air can circulate through the cotton.

If the cotton is mixed by hand, a quantity from each lot is spread over the floor of the bin, or space to be occupied by the stack. This is followed by another layer from a different lot and so on until the stack has been formed.

The size of the mixing will depend upon the size of the mill, and the circumstances under which it is to be made. Good results, however, can be obtained by making a mixing large enough to supply the mill from 3 days to one week.

In small mills it may be convenient to make the mixing in the same room as the picker machinery, but where a very large mixing is necessary a room should be provided for this purpose, and is known as the "Mixing Room."

Mixing Machinery.

In large mills it has become the practice to employ machinery to make the mixings in place of building stacks by hand. This is done with a view to mixing more thoroughly and reducing the labor cost.

The machine used to assist in forming a mixing is known as a Bale-Breaker, or as is sometimes called a "cotton puller" on account of its action upon the cotton resembling

greatly the operation of tearing the cotton into small bunches by hand. It is upon this point that better blending is claimed when the bale breaker is used; because the cotton being in smaller pieces than when mixed by hand, per-

BALE BREAKER

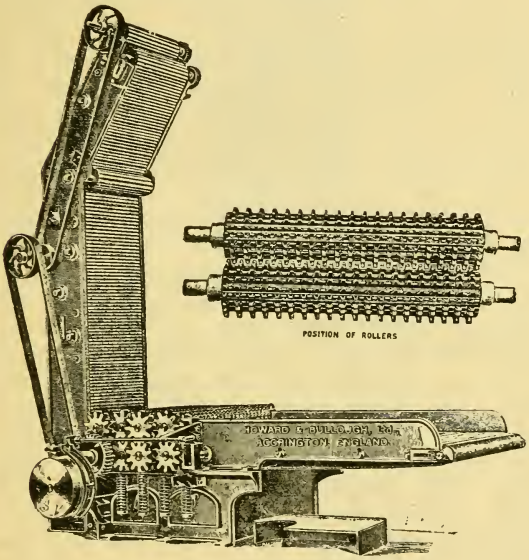

FIG. 4.

mits the different varieties to amalgamate more thoroughly and the cotton laying in a more loose condition dries out to greater advantage, thus giving a more even running

thread when passing through the mill (i. e., other conditions being favorable).

Bale Breakers.

The bale breaker shown in Fig. 4 consists of a feed apron of the lattice type, which is constructed of a number of wood slats, attached to two endless belts or chains. The latter are supported by and driven at a regular rate by rolls placed at convenient distances apart; the whole arrangement forming a flexible feed table. Immediately in front of the feed apron or lattice are (from 2 to) 4 pairs of rolls which may be either fluted or crosscut and driven by an arrangement of gearing connecting each pair of rolls. The bottom rolls revolve in fixed bearings, while the top rolls revolve in movable bearings, but are usually kept in contact with the bottom rolls by spiral springs, so that when an extra large piece of cotton, or any very hard substance passes, the roll may yield, and so avoid damage. The speed of the various rolls from feed to delivery increases rapidly, and the effect is, that if four are used, the cotton is well opened before being delivered. The extent to which the speed of the front roll is increased over the back roll is known as the "draft" of the machine, and this phrase is applied to all the processes of attenuation occurring in the whole series of machines, from this point through to the finished yarn. There is a divergence of opinion as to the correct draft of a bale breaker, but the advantage lies with the adoption of a large one, in order to get the cotton into the best pos-

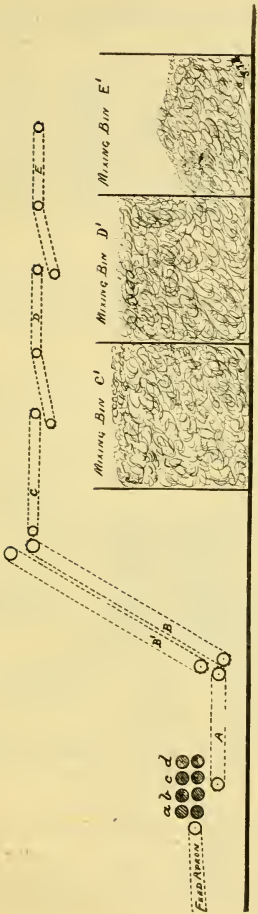

FIG. 5. METHOD OF CONVEYING COTTON FROM BALE BREAKER TO MIXING BINS.

sible condition for opening, at the earliest stage. There are limitations to this procedure, and different cottons require different treatment; but a draft of from 30 to 40 seems most suitable for practical purposes.

It may be well at this point to briefly state that the meaning of "draft" as applied above, is the ratio between the surface speed of the feed roll and the surface speed of the delivery roll.

For example, if the feed roll **a**, Fig. 5, is the same diameter as the delivery roll **d**, and **a** makes one revolution while **d** makes 30, the "draft" is said to be 30.

Again, suppose **a** makes 1 (one) revolution, **b** 2 (two) revolutions, **c** 6 (six) revolutions and **d** 30 (thirty) revolutions in the same time, and all the rolls be the same diameter, the total draft would be 30, and this would be divided into the following intermediate drafts:

Draft between **a** and **b** = 2
Draft between **b** and **c** = 3
Draft between **c** and **d** = 5

The product of intermediate drafts equals 2 x 3 x 5 = 30 total.

It will be seen, however, from the above, that the action of the rolls, will by the time the cotton has passed through the machine, have pulled the cotton into comparatively small pieces. It will be noticed also, that this opening up of the mass of cotton is in accordance with the essential points to be observed in cotton manufacturing; viz.: to extract as much dirt, sand, leaf, etc., at the earliest stage possible. In addition to the machine already de-

scribed there are other arrangements of Bale Breaker two of which are shown in Figs. 6

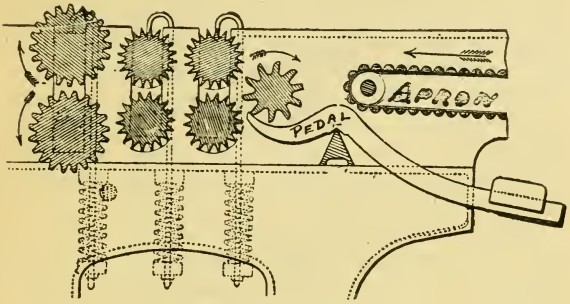

FIG. 6. SECTION OF PEDAL BALE BREAKER.

and 7; the former is for working similar classes of cotton as the one shown in Figs. 4

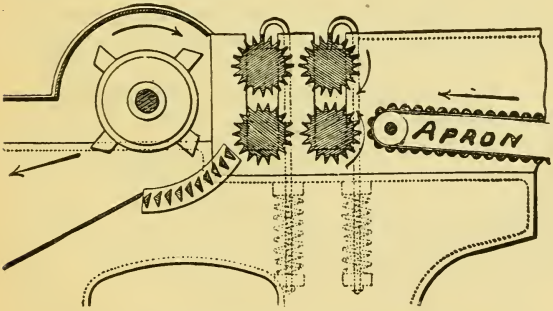

FIG. 7. SECTION OF PORCUPINE BALE BREAKER.

and 5, viz.: long and medium staple; but, in place of having four pairs of rolls, it is con-

structed with one fluted pedal roll under which is placed a set of pedals, and three pairs of rolls weighted by strong spiral springs; the top of the first and second pairs are made in sections with strong teeth and the bottom rolls and the third pair of rolls coarse fluted.

By this arrangement an independent grip is obtained upon the cotton at several points in the width of the machine, and thus ensures a more positive opening of the sheet; which is usually taken in layers from the bale.

Fig. 7 represents a section of a bale breaker built specially for short stapled cotton, and contains only two pairs of rolls, weighted and constructed in a similar manner as those in Fig. 6. It also contains a small porcupine beater about 14 inches in diameter. The teeth are hardened steel, and are usually secured to discs, these in turn being threaded on a shaft.

The production of the machines just described is from 70,000 to 90,000 lbs. per week, and requires about 2 horse power to drive.

Owing to the heavy work performed by the bale breaker, the machine is built very strong. It is customary in some cases to make the rolls of a number of discs which are threaded on a shaft and bolted together, so that in case of a tooth being broken from any cause, the disc can be broken off and a new one added at the end.

One method of making a mixing or number of mixings by the use of a bale breaker, is shown in Fig. 5, and represents a good method when the machine and the mixing are in the same room.

Referring to the sketch it will be noticed that three mixing bins are used to which the cotton is conveyed by aprons A, B, C, D and E connecting with the bale breaker, from which the cotton is delivered as previously described, in a somewhat loose condition onto the apron A situated near the floor in front of the machine; this apron takes the cotton and deposits in onto the upright apron B, then between B and B′, the cotton is carried almost to the top of the room. A close observation will show the apron B to be set lower than B′ and this has a two fold object. In the first place it allows B to receive the cotton at the bottom, while it also allows B′ to prevent the cotton falling back onto the machine, therefore causing it to be delivered onto the apron C which is supported near the ceiling.

When the mixing is to be made in bin E′ the cotton is carried by C and delivered onto D, and this in turn delivers it onto E which drops it into the bin.

If, however, a mixing is to be made in D′, the apron E (by means of a handle and gearing) is caused to travel backwards; so that when D delivers the cotton to E, the latter carries it back between D and E and drops it into the bin D′. To make a mixing in C the same arrangement is provided to reverse apron D, thus dropping the cotton between C and D into the bin C′.

Other arrangements of conveying cotton can be made, as no definite rule can be given for locating the mixing, and circumstances

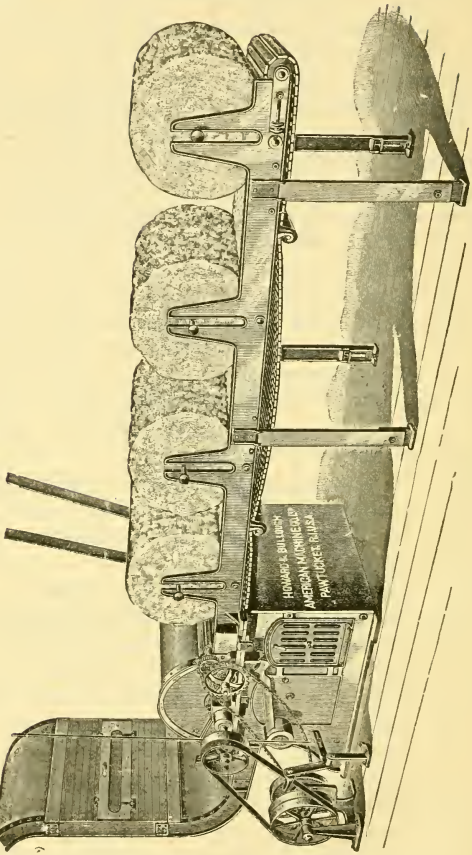

FIG. 8. BALE BREAKER FOR ROUND LAP BALES.

will not always permit the bale breaker to be in the same room as the mixing.

If, however, the mixing should be in the room below the bale breaker, it would only be necessary to place a tube in the ceiling of the mixing room in such a position that the cotton could be delivered through the tube onto the apron C, from whence it could be distributed to any of the other mixings.

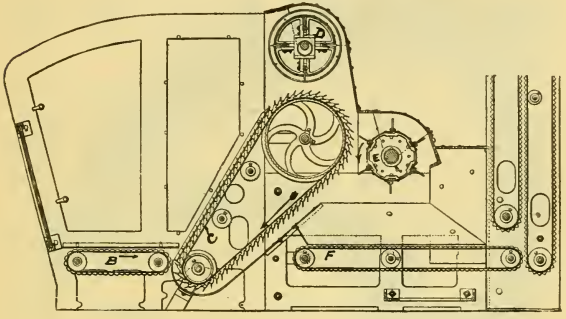

FIG. 9. SECTION OF HOPPER BALE BREAKER.

In case of cylindrical bales being used, a bale breaker with a section somewhat similar to that shown in Fig. 7 is employed, except that when "round lap bales" are being treated, a creel is provided for holding 4 bales, which are unwound by means of a feed apron as shown in Fig. 8, and fed to the rolls of the bale breaker in a continuous sheet.

A sectional view of one of the latest styles of bale breaker is shown in Fig. 9.

The machine is constructed on the Auto-

matic feeding principle, and is meeting with considerable success and adoption.

The following claims are made for it over the old style:

1st. It opens the cotton better, without damage to the fibres.

2d. The amount of opening required can be regulated by an adjustable stripping cylinder D, Fig. 9.

3d. By opening the cotton better, a more uniform mixing can be obtained, while waste can also be mixed and become more evenly distributed throughout the mixing.

4th. A large production; this will depend upon the amount of opening required, but a bale can be opened in 5 or 6 minutes when necesary, giving a weekly output of from 100,000 to 150,000 lbs.

A general description of the machine will now be given, illustrating its action on the cotton.

After the bales have been opened, large pieces ranging from 40 to 80 lbs. can be thrown into the bin, or hopper, Fig. 9, and by means of the apron B, which is continually moving in the direction shown by the arrow, the cotton is carried against the spiked apron C, which in turn receives the cotton, and by means of spikes inserted into the laths, the cotton is pulled into pieces and conveyed toward the spiked stripping roll D. This roll is adjustable, and according to the distance at which it is set from the apron, depends the amount of opening that the cotton receives, the greatest amount of opening being obtained

when this roll is at its closest point to the apron.

An enlarged section of the spiked apron is shown in Fig. 10; this is made extra strong, with the laths intersecting into each other in such a manner that no cotton can accumulate between them.

The cotton which passes beneath the spiked

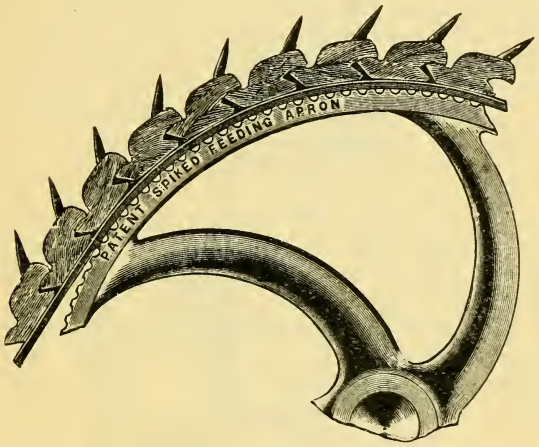

FIG. 10. ENLARGED SECTION OF THE APRON C, SHOWN IN FIG. 9.

roll D is removed from the apron by means of the beater E, which has 6 leather flaps acting in such a manner that the cotton is struck from the spiked apron and deposited upon the apron F, from which it may be delivered to any point desired by means of upright aprons, etc., as explained in connection with the previous bale breakers.

In connection with this style of machine an arrangement is employed for conveying the dust away from the machine by placing tubes over the feed box, and drawing away the dust by means of a fan, and discharging it in the dust room or other convenient place.

Fig. 11 represents an arrangement whereby the bale breaker may be situated in the same building as the cotton storage rooms, apart from the main mill, and by means of fans the cotton is drawn through a trunk and deposited at some convenient point in the main mill.

The horse power required for these machines is from 2 1/2 to 3 I. H. P.

The floor space required is about 9 1/2 x 7 feet.

When mixing different grades of cotton a proportion must be obtained to determine the exact amount to take from each lot at different stages in the formation of the mixing.

For instance, if we wish to make a mixing to contain 56 bales, and the following marks represent each lot; viz.:

32 bales marked W. W. S.
16 bales marked S. G.
8 bales marked Y. W.,

we may proceed as follows:

Divide each lot by bales in smallest lot.

Thus $32 \div 8 = 4$
$16 \div 8 = 2$
$8 \div 8 = 1$

Therefore if a bale breaker is being used, we

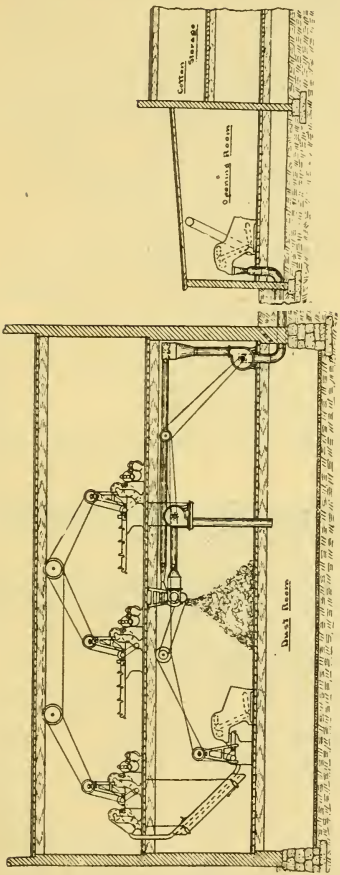

FIG. 11. ARRANGEMENT FOR CONVEYING OPENED COTTON, FROM COTTON SHED TO MIXING ROOM.

may open 7 bales, feeding in either one of the following orders, viz.,

1 from S. G.
2 from W. W. S.
1 from Y. W.
1 from S. G.
2 from W. W. S.

or

2 from W. W. S.
1 from S. G.
1 from W. W. S.
1 from Y. W.
1 from W. W. S.
1 from S. G.

Repeating the above until all the bales are mixed.

To find the per cent. of each kind in a mixing, apply the following:

First, ascertain the total amount in the mixing; for instance taking the last example and assuming the bales to equal 500 lbs. net, we obtain a mixing of 28,000 lbs.

Thus, 32 bales of W. W. S. x 500 =	16,000 lbs.
16 bales of S. G. x 500 =	8,000 lbs.
8 bales of Y. W. x 500 =	4,000 lbs.
Total,	28,000 lbs.

Then, multiply weight of each lot by 100, and divide result by total weight of mixing.

Then W. W. S. $= \frac{16000 \times 100}{28000} = 57\ 1/7$ per cent.
S. G. $= \frac{8000 \times 100}{28000} = 28\ 4/7$ per cent.
Y. W. $= \frac{4000 \times 100}{28000} = 14\ 2/7$ per cent.

Assuming the price of each lot to be as follows, we may find the average price per pound of the mixing:

W. W. S. = 11c. per lb.
S. G. = 10c. per lb.
Y. W. = 8c. per lb.

Then divide the total cost of the mixing by the total weight.

For example:

16,000 lbs. of	W. W. S. at 11c. =	$1,760.00
8,000 lbs. of	S. G. at 10c. =	800.00
4,000 lbs. of	Y. W. at 8c. =	320.00
Total cost,		$2,880.00

Then 288,000 cents divided by 28,000 lbs. = 10 2/7c. per lb. average price.

Notes on the Management of the Mixing Room.

1st. Always make your mixing as large as possible, as a more even running yarn will be obtained.

2d. Keep the temperature of the mixing room about 75 deg. F., as this will be found to give the best results, owing to the fact that the fibres will retain a normal supply of moisture at this temperature.

3d. When a mixing stack has been formed, always take the cotton from the side or breast

of the stack, as you will then take from each layer and not have the same tendency to feed the respective layers separately, which would partially destroy the object of the mixing.

4th. It is advisable to have two mixings if convenient, as one can be made while the other is being used.

5th. The size of the mixing must be governed by circumstances, but provision should be made whenever possible for mixings to last from three days to one week.

6th. Mixing can be accomplished at any of the following places:

(a) Mixing Room .

(b) Picker Room by feeding different kinds of laps on Intermediate, or on Finisher Pickers.

(c) At the drawing frame.